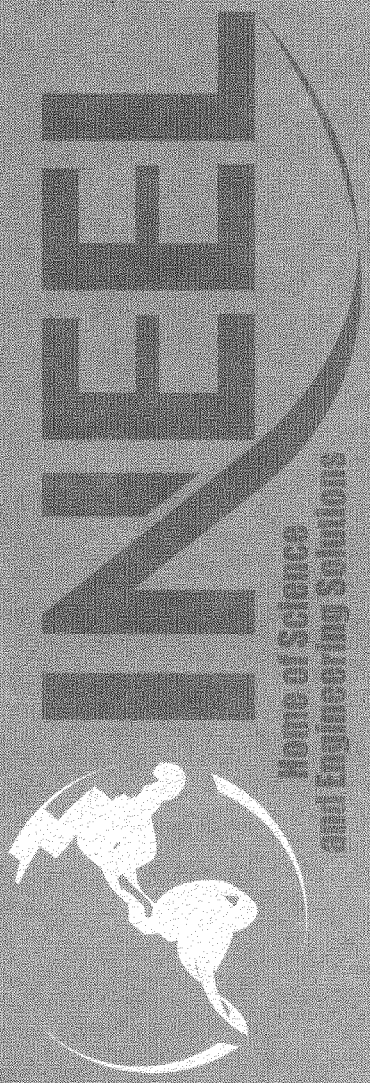
INEEL/EXT-03-00055
Revision 0
Project No. 023378

FY 2002 Environmental Monitoring Report for the Radioactive Waste Management Complex

Gail L. Olson
L. Don Koeppen
Alva M. Parsons
Paul D. Ritter
A. Jeffrey Sondrup
March 2003



Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho, LLC

INEEL/EXT-03-00055
Revision 0

FY 2002 Environmental Monitoring Report for the Radioactive Waste Management Complex

Gail L. Olson
L. Don Koeppen
Alva M. Parsons
Paul D. Ritter
A. Jeffrey Sondrup

March 2003

Idaho National Engineering and Environmental Laboratory
Environmental Restoration Program
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Assistant Secretary for Environmental Management
Under DOE Idaho Operations Office
Contract DE-AC07-99ID13727

ABSTRACT

This report summarizes data resulting from monitoring the air, waste zone, vadose zone, and aquifer in and around the Radioactive Waste Management Complex within the Idaho National Engineering and Environmental Laboratory. This report is a joint publication of the Environmental Restoration and Waste Management programs, and the results summarized here are used to satisfy several requirements and needs. The WM Program uses the results to comply with requirements of U.S. Department of Energy Order 435.1, "Radioactive Waste Management," Chapter IV, and the associated implementation manual and guidance, which require monitoring of low-level radioactive waste disposal facilities. The ER Program uses the monitoring results to support activities associated with the ongoing Comprehensive Environmental Response, Compensation and Liability Act risk assessment for Waste Area Group 7, which comprises the RWMC.

Data from FY 2002 are presented in detail, and data from FY 1997 through FY 2001 are summarized to facilitate evaluation of temporal and spatial trends. Organic contaminants are shown to be declining in the soil gas because of ongoing vapor vacuum extraction efforts in the vadose zone. Radionuclide detections are evaluated over time and within the context of disposals to determine whether there are any candidate nuclides for model calibration efforts. Technetium-99, C-14, and H-3 are regularly detected at one or more locations, but the detections do not correlate well with the disposal locations. Trends in the uranium detections correlate with the disposal locations and may be useful for validating some modeling assumptions. Detections are sporadic for Am-241, Ce-137, Cl-36, I-129, Np-237, plutonium, and Sr-90; therefore, these data are not useful for modeling at this time. Soil gas and atmospheric data collected near Soil Vault Rows 12 and 20 suggest that C-14 and H-3 are migrating from disposals of beryllium blocks and activated metal.

CONTENTS

FIGURES

TABLES

ACRONYMS

bls	below land surface
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	contaminant of concern
CY	calendar year
DOE	U.S. Department of Energy
ER	environmental restoration
FY	fiscal year
GC/MS	gas chromatography and mass spectrometry
GSP	gas sampling port
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology Engineering Center
MCL	maximum contaminant level
MDA	minimum detectable activity
OCVZ	organic contamination in the vadose zone
PA/CA	performance assessment and composite analysis
PCE	tetrachloroethene
RBC	1E-05 risk-based concentration
RFP	Rocky Flats Plant
RWMC	Radioactive Waste Management Complex
SDA	Subsurface Disposal Area
SRPA	Snake River Plain Aquifer
SVR	soil vault row
1,1,1-TCA	1,1,1-trichloroethane
TCA	trichloroethane
TCE	trichloroethene

TRA	Test Reactor Area
TRU	transuranic
USGS	U.S. Geological Survey
VOC	volatile organic compound
VVET	vapor vacuum extraction with treatment
WAG	Waste Area Group
WM	waste management

FY 2002 Environmental Monitoring Report for the Radioactive Waste Management Complex

1. INTRODUCTION

The Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering and Environmental Laboratory (INEEL) has been used for waste disposal operations since the 1950s. The RWMC occupies about 177 acres (71.6 ha) in the southwestern quadrant of the INEEL (see Figure 1-1), and is divided into three areas: (1) the Subsurface Disposal Area (SDA), where radioactive and hazardous waste has been disposed of, (2) the Transuranic Storage Area, and (3) the administration and operations area. Contaminant concentrations are routinely monitored within and around the RWMC in soil gas, soil moisture, and the Snake River Plain Aquifer (SRPA) to determine whether waste buried in the SDA is impacting the environment. In addition, special studies are conducted to determine whether contaminants can be detected in the atmosphere and other media. Results from these hydrological monitoring activities are used to support the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 USC § 9601 et seq.) risk assessment in the Environmental Restoration (ER) Program, and the Performance Assessment and Composite Analysis (PA/CA) Monitoring Program in the Waste Management (WM) Program.

This report is a joint effort of the ER and WM programs to compile environmental monitoring results for RWMC from Fiscal Year (FY) 1997 through FY 2002, with emphasis on recent results. Data previous to FY 2002 are presented to evaluate the presence or absence of contaminant trends.

1.1 Purpose and Scope

Monitoring results summarized in this report are used to satisfy several requirements and needs. The WM Program uses the results to comply with requirements of U.S. Department of Energy (DOE) Order 435.1, "Radioactive Waste Management," Chapter IV, and the associated implementation manual and guidance, which require monitoring of low-level radioactive waste disposal facilities. In particular, the following requirements of the order must be addressed:

- Site-specific PA/CA will be used to determine the media, locations, radionuclides, and other substances to be monitored.
- The environmental monitoring program will be designed to include measuring and evaluating releases and migration of radionuclides.
- The environmental monitoring program will be capable of detecting changing trends in performance to allow application of necessary corrective action before exceeding the performance assessment objectives. The performance objectives (i.e., action levels) for FY 2002 are discussed and compared with monitoring results in the PA/CA annual review (Parsons, McCarthy, and Seitz 2003).

The ER Program uses the monitoring results to support activities associated with the ongoing CERCLA risk assessment for Waste Area Group (WAG) 7, which comprises the RWMC. Operable Unit (OU) 7-13/14 is the designation for the comprehensive operable unit for WAG 7 recognized under the Federal Facility Agreement and Consent Order (DOE-ID 1991) and CERCLA.

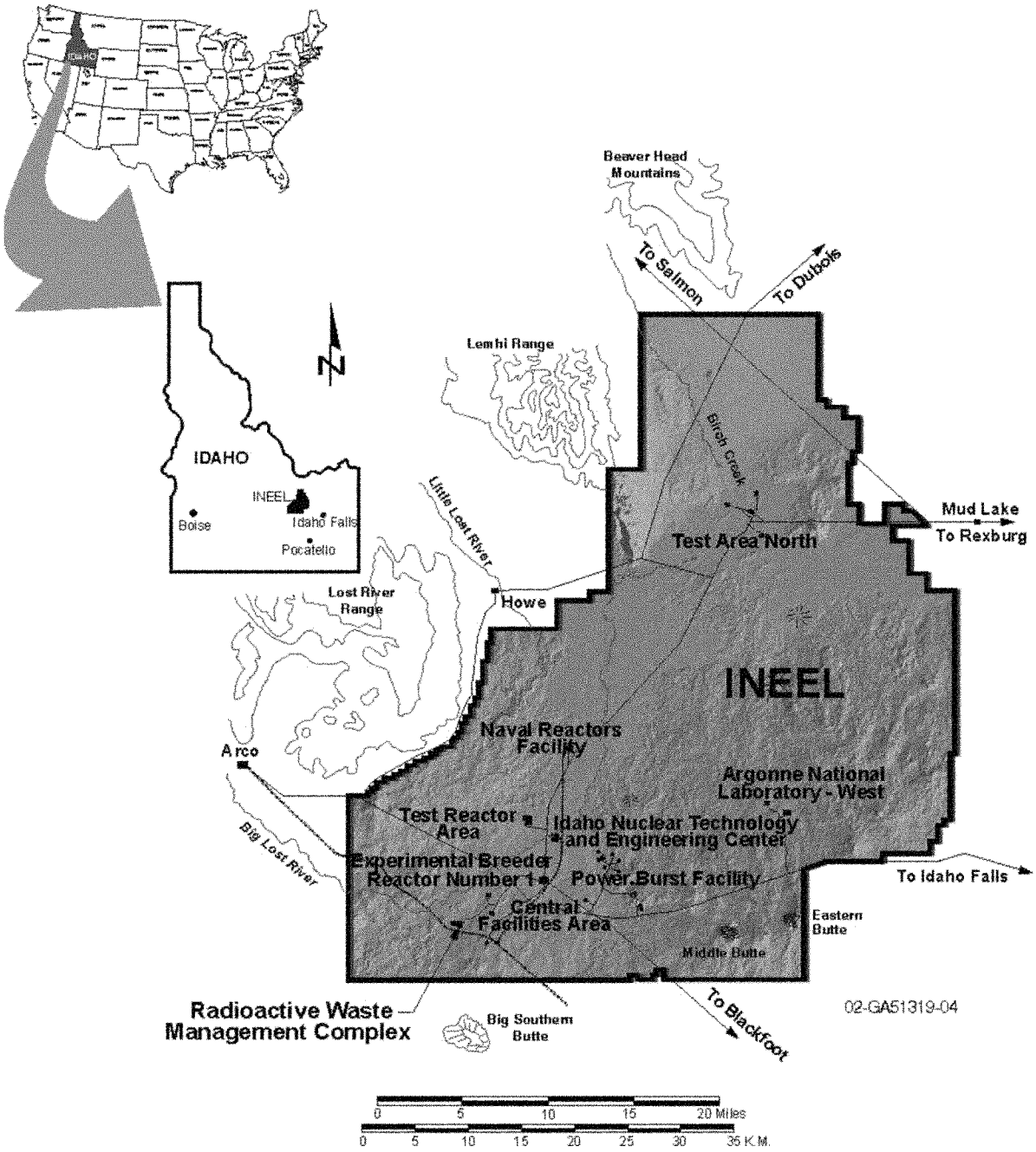


Figure 1-1. Map of the Idaho National Engineering and Environmental Laboratory showing the Radioactive Waste Management Complex and other major program sites.

Environmental monitoring data are used to support the following OU 7-13/14 objectives:

- Assess whether contaminants are being released from the waste zone
- Provide baseline data to choose monitoring locations to support the upcoming, comprehensive record of decision for OU 7-13/14
- Provide modelers with candidate calibration targets
- Verify conservatism in risk assessment modeling.

Monitoring priorities are established by collaboration between the ER and WM programs and other data users. The required data for the RWMC PA/CA Monitoring Program are identified in the *Performance Assessment and Composite Analysis Monitoring Program* description (McCarthy, Seitz, and Ritter 2001). Contaminants of concern (COCs) for the CERCLA risk assessment are identified in *OU 7-13/14 Ancillary Basis for Risk Assessment* (ABRA) (Holdren et al. 2002) and include radionuclides plus some organics and nitrates. Table 1-1 summarizes contaminants of interest for the two programs.

Figure 1-2 shows the layout of disposal units at the SDA. More detailed maps of the SDA, additional information on the environmental setting and history of disposal operations at the SDA, and the disposal inventory are presented in the ABRA (Holdren et al. 2002).

Table 1-1. Contaminants of interest to the Performance Assessment and Composite Analysis Monitoring Program and Operable Unit 7-13/14.

Contaminants of Interest to the Performance Assessment and Composite Analysis Monitoring Program	Contaminants of Interest to Operable Unit 7-13/14
C-14	Am-241
Cl-36	C-14
I-129	H-3 (potential calibration target)
Np-237	I-129
U-234	Nb-94
U-238	Np-237
	Plutonium (special case contaminant)
	Sr-90
	Tc-99
	U-233
	U-234
	U-235
	U-236
	U-238
	Carbon tetrachloride
	Methylene chloride
	Nitrates
	Tetrachloroethylene

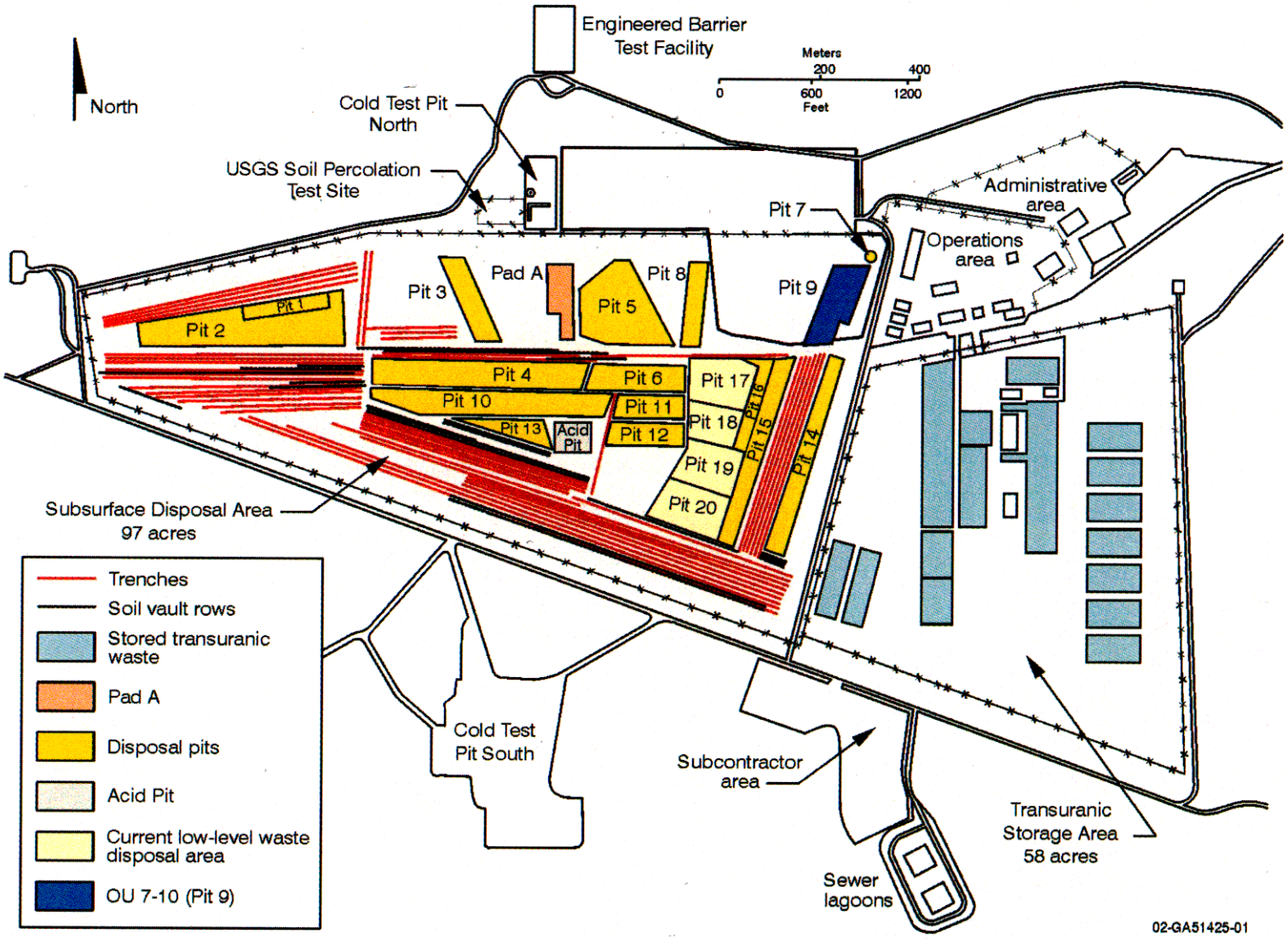


Figure 1-2. Waste disposal locations at the Radioactive Waste Management Complex.

2. MONITORING AT THE RADIOACTIVE WASTE MANAGEMENT COMPLEX

Environmental samples are routinely collected within and around the RWMC area and analyzed for a variety of radionuclide, nonradionuclide, and organic contaminants that are potential risk drivers. The routine monitoring program supporting ER and WM program objectives focuses on sampling the waste zone, the vadose zone, and the aquifer including soil-moisture, soil-vapor and gas, perched-water, and aquifer sampling. Soil moisture samples are collected from lysimeters within the waste zone, and soil vapor and gas samples are collected from vapor ports to evaluate organic contaminants. Perched-water samples are collected above some of the interbeds.

2.1 Soil Moisture Sampling

Soil moisture samples are collected quarterly with suction lysimeters throughout the waste and vadose zones of the SDA. Installation of lysimeters in the SDA began in 1985 with the Subsurface Investigation Program and continues today based on emerging interests and needs. A description of how the lysimeters are installed is provided in Section 2 of the ABRA.

Lysimeter samples are limited in volume. Some lysimeters yield only a couple of milliliters per sampling event, while a few lysimeters occasionally yield up to approximately 600 mL. Because not all analyses of interest can be performed with the limited sample volume, analytical priorities have been established for the lysimeter samples. The priorities recently were revised based on collaboration between ER and WM, but have not yet been implemented. Analytical priorities before and after revision are provided in Table 2-1.

Table 2-1. Analytical priorities before and after Fiscal Year 2003.

Analytical Priorities for Lysimeters Before Fiscal Year 2003	Analytical Priorities for Fiscal Year 2003
Gamma emitters	C-14
Tc-99	Tc-99/Gamma emitters
Uranium, plutonium, and Am-241	Uranium, plutonium, and Am-241
Np-237	Anions (one quarter only)
C-14	Metals (one quarter only)
I-129	H-3
H-3	Cl-36

Locations for the 18 waste-zone lysimeters were chosen based on a need to investigate specific focus areas. The waste zone lysimeters were placed from 1.5 to about 9 m (5 to about 30 ft) deep and are in or just below the target waste, at the point of waste and underburden contact, or at the point of contact with the underlying basalt. Locations of the focus areas are shown in Figure 2-1. The number of lysimeters per focus area is as follows:

- Two in the Uranium/Enriched Uranium Focus Area
- Two in the Americium/Neptunium Focus Area
- Six in the Organic Sludge Focus Area
- Six in the Depleted Uranium Focus Area

- Two in the Activated Metal Focus Area near Soil Vault Row (SVR) 12.

The only lysimeter providing a sample is located within the Americium/Neptunium Focus Area, and it was dry for the last sampling round.

Twenty-nine sampled lysimeters are in the shallow vadose zone (0 to 11 m [0 to 35 ft] deep) (see Figure 2-2), and 15 lysimeters are in the intermediate vadose zone (11 to 43 m [35 to 140 ft] deep) (see Figure 2-3). Unlike the waste-zone lysimeters, the shallow vadose-zone lysimeters are located adjacent to the waste in undisturbed sediments, not within disposal units or next to waste. The intermediate vadose-zone lysimeters are located beneath the depth of the waste zone, generally in basalt or interbed sediments.

At a depth greater than 43 m (140 ft), both lysimeters and wells provide samples (see Figure 2-4). Samples from Wells U.S. Geological Survey (USGS) -92 and -8802D are used to collect perched water from above the 67-m (220-ft) interbed.

2.2 Aquifer Sampling

Aquifer samples are collected quarterly by the INEEL. Data also are collected by the USGS, but the data are not immediately available for use; therefore, the USGS data are not included here (except for organic contaminants). Aquifer well locations are shown in Figure 2-5.

2.3 Monitoring of Organic Contaminants

Routine monitoring for organic contaminants is conducted at the SDA in the atmosphere, shallow and deep soil gas, vadose zone, perched water, and aquifer. Sample locations and additional details are provided in the discussion of organic contaminant monitoring (see Section 4).

2.4 Special Studies

In addition to routine monitoring of the aquifer and vadose zone, some special studies are conducted to determine the extent of contaminant release from select waste forms. These include monitoring H-3 and C-14 releases from buried beryllium blocks, active pit monitoring, and lysimeter and gas-phase monitoring in the Integrated Probing Project. Results from these studies are incorporated into the sections discussing the contaminant monitored. For example, the C-14 data from the beryllium block and activated metal investigation are included in Section 4.2.

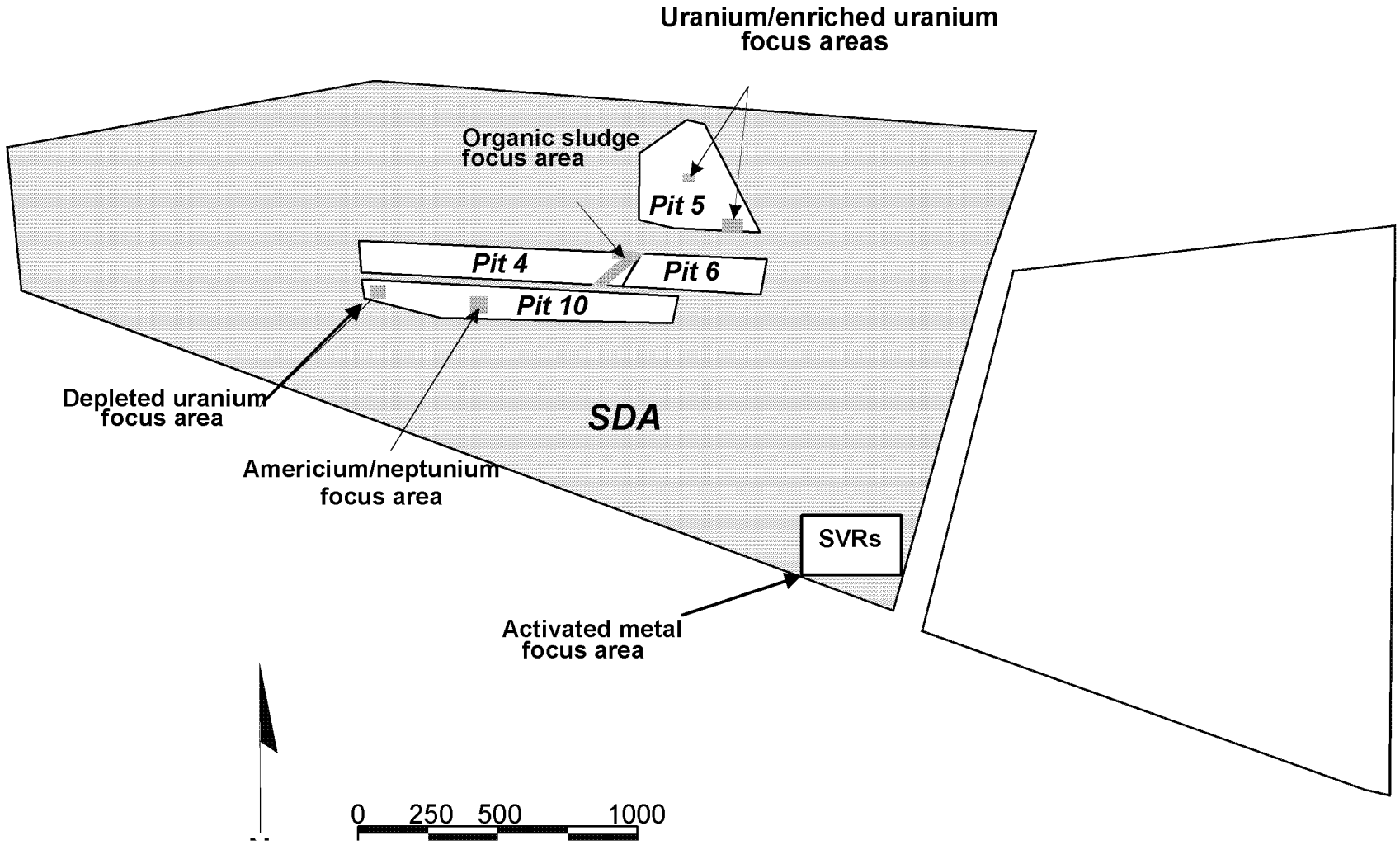


Figure 2-1. Location of focus areas at the Subsurface Disposal Area.

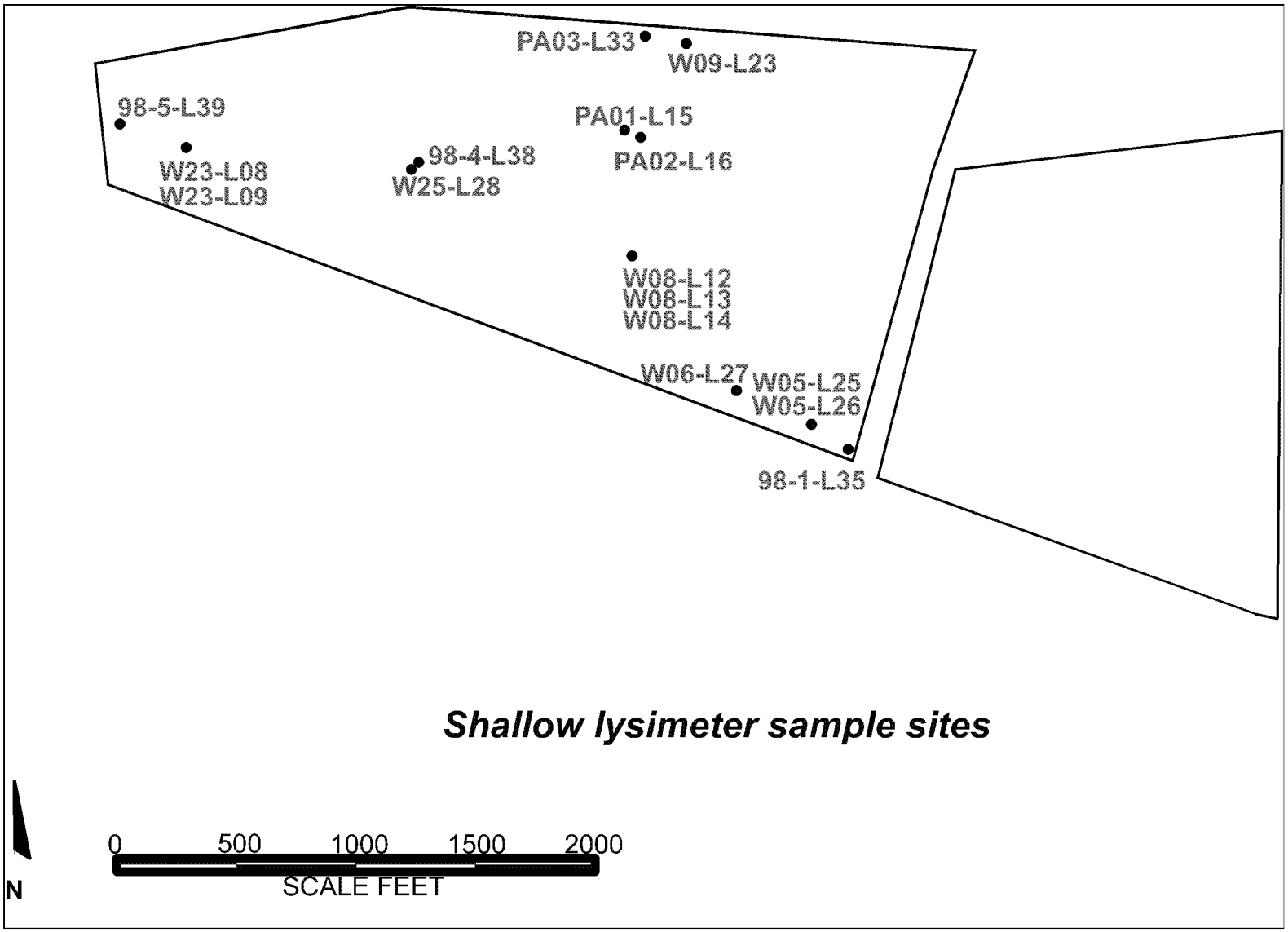


Figure 2-2. Lysimeters installed in the Subsurface Disposal Area at a depth of 0 to 35 ft. Only lysimeters targeted for sampling are shown.

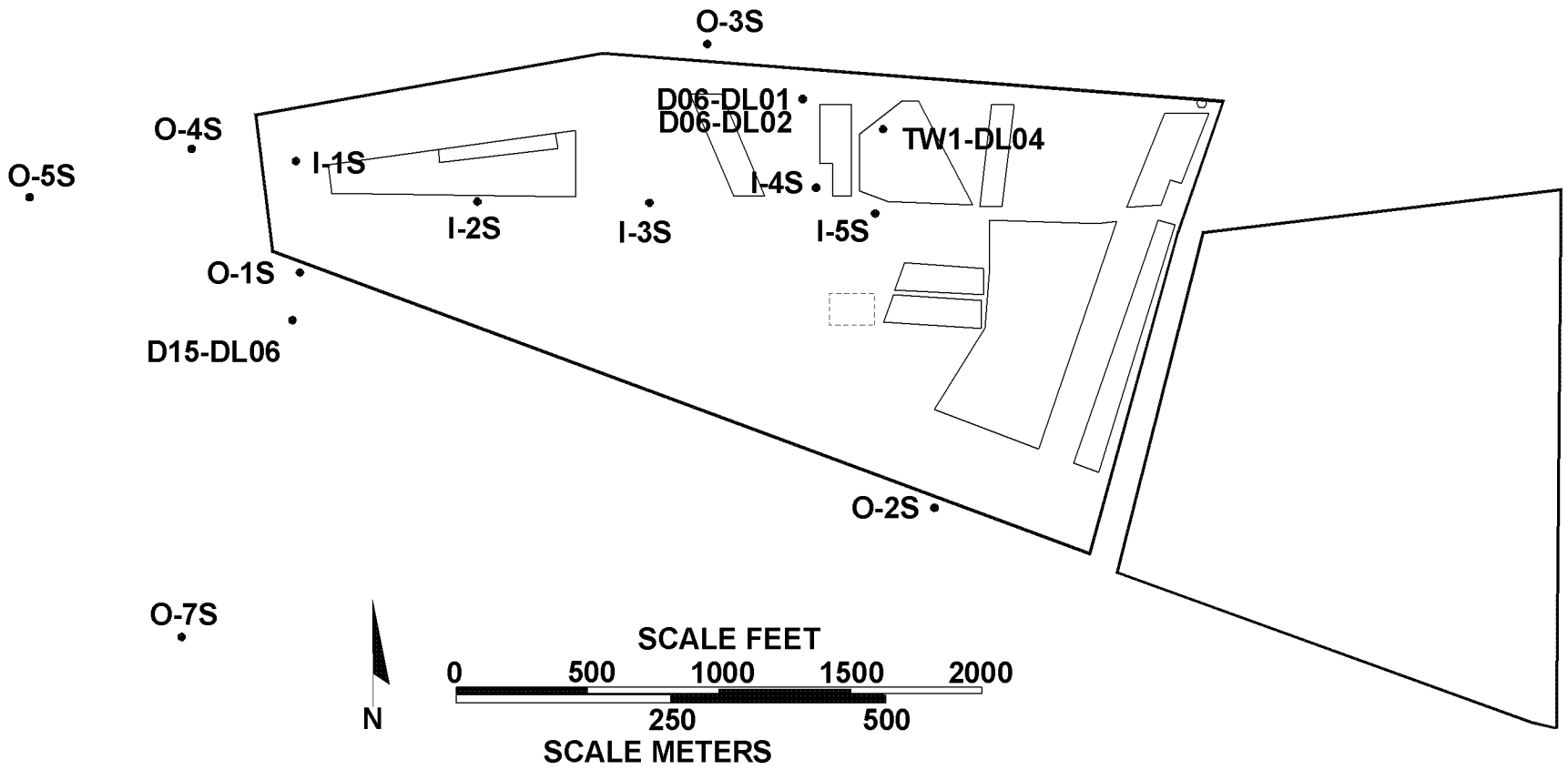


Figure 2-3. Lysimeters located at the intermediate depth interval (35 to 140 ft]). Only lysimeters targeted for sampling are shown.

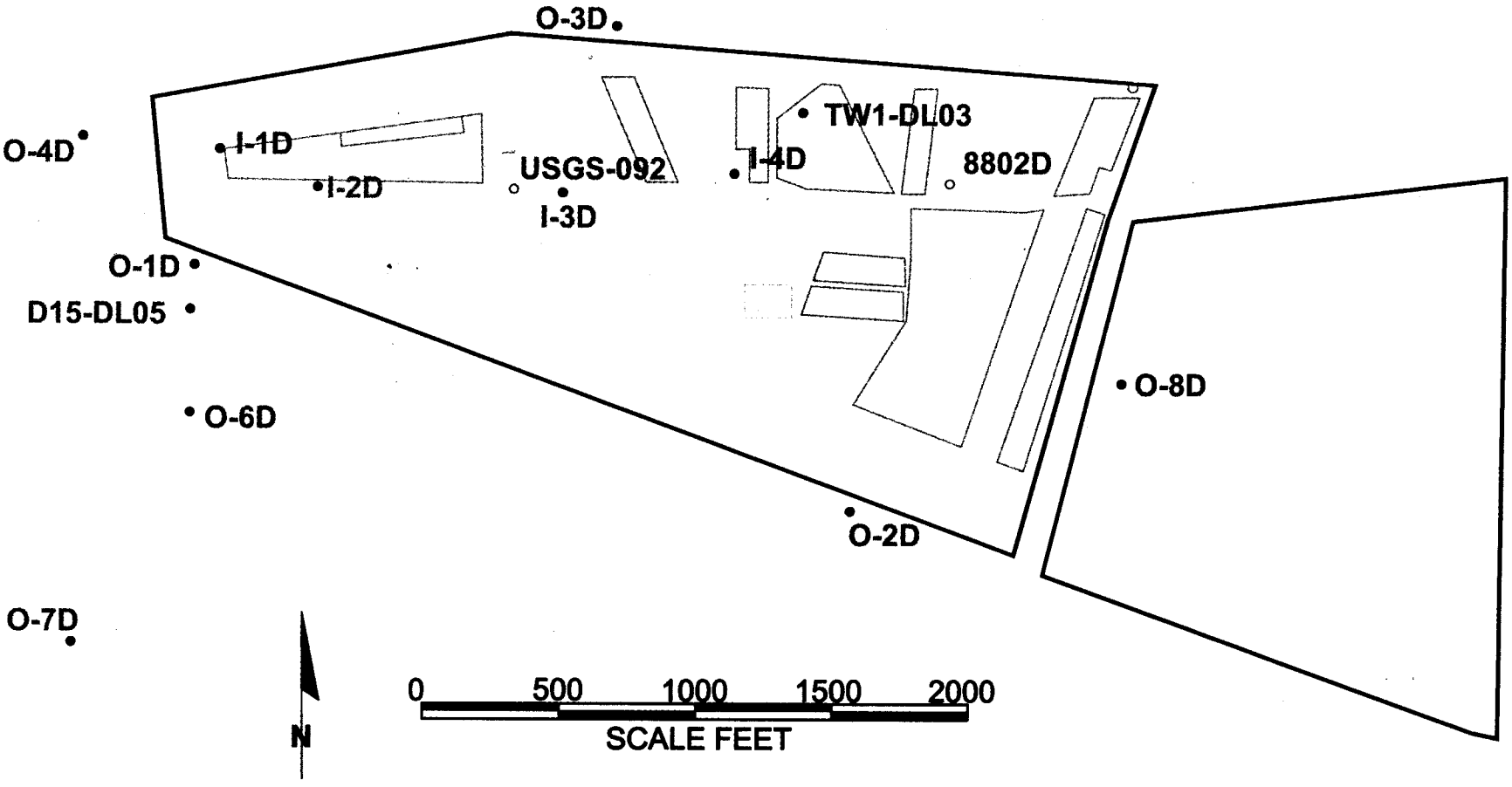


Figure 2-4. Lysimeter and perched-water sampling locations in the vadose zone deeper than 140 ft. Only those locations targeted for sampling are shown.

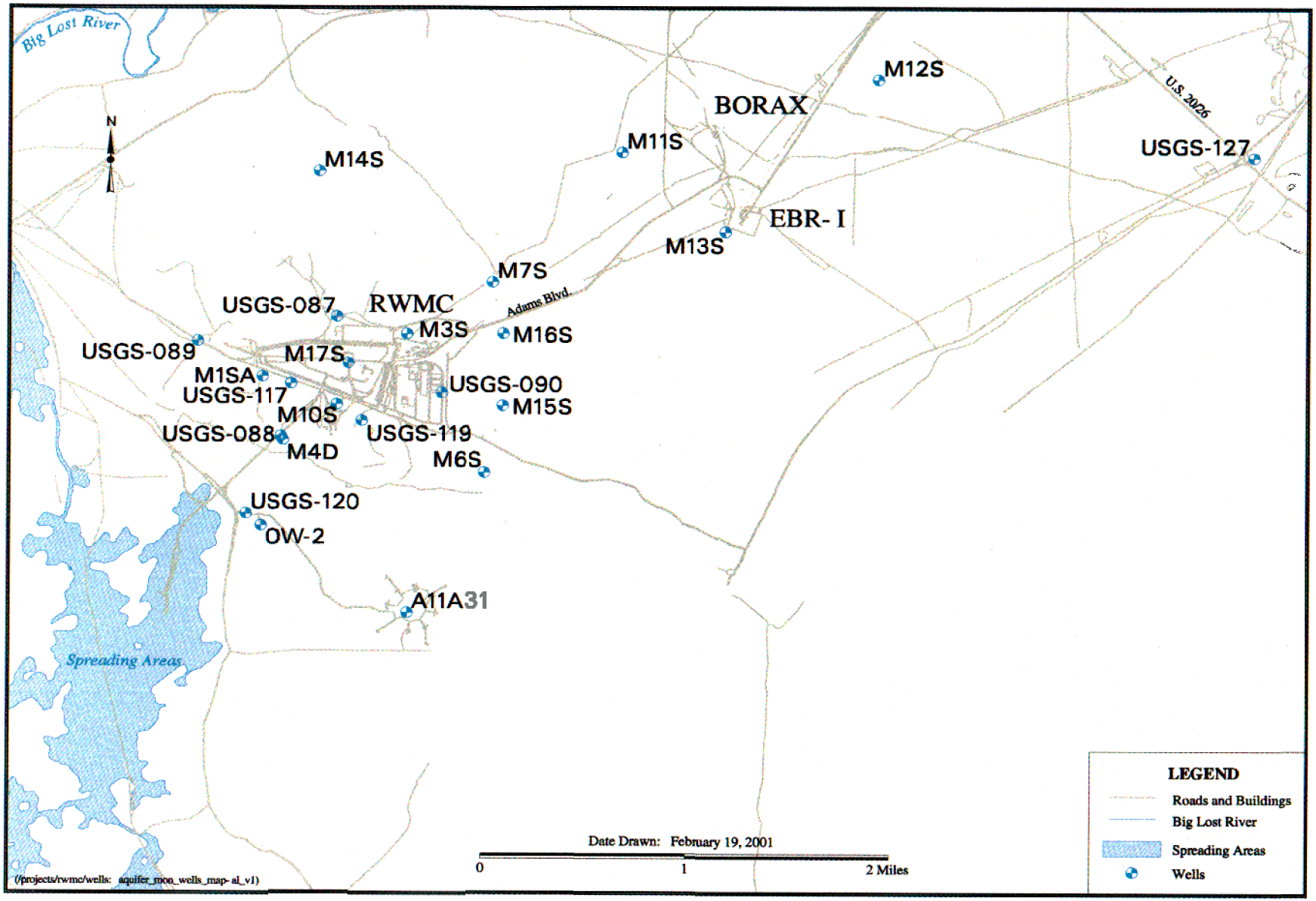


Figure 2-5. Aquifer-monitoring wells at the Radioactive Waste Management Complex.